Micropower Dual CMOS Voltage Comparator

The NCV2393 and TS393 are micropower CMOS dual voltage comparators. They feature extremely low consumption of 6 μ A typical per comparator and operate over a wide temperature range of $T_A=-40$ to 125°C. The NCV2393 and TS393 are available in an SOIC–8 package.

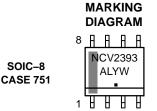
Features

- Extremely Low Supply Current: 6 µA Typical Per Channel
- Wide Supply Range: 2.7 to 16 V
- Extremely Low Input Bias Current: 1 pA Typical
- Extremely Low Input Offset Current: 1 pA Typical
- Input Common Mode Range Includes VSS
- High Input Impedance: $10^{12} \Omega$
- Pin-to-Pin Compatibility with Dual Bipolar LM393
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb–Free, Halogen Free/BFR Free and are RoHS Compliant



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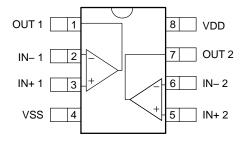
A = Assembly Location

= Wafer Lot Y = Year

W = Work Week

■ = Pb-Free Package

PIN CONNECTIONS



ORDERING INFORMATION

Device	Package	Shipping [†]
NCV2393DR2G	SOIC-8 (Pb-Free)	2500 / Tape & Reel
TS393DR2G	SOIC-8 (Pb-Free)	2500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

PIN DESCRIPTION

Pin	Name	Туре	Description
1	OUT 1	Output	Output of comparator 1. The open-drain output requires an external pull-up resistor.
2	IN- 1	Input	Inverting input of comparator 1
3	IN+ 1	Input	Non-inverting input of comparator 1
4	VSS	Power	Negative supply
5	IN+ 2	Input	Non-inverting input of comparator 2
6	IN- 2	Input	Inverting input of comparator 2
7	OUT 2	Output	Output of comparator 2. The open-drain output requires an external pull-up resistor.
8	VDD	Power	Positive supply

ABSOLUTE MAXIMUM RATINGS (Note 1)

Over operating free-air temperature, unless otherwise stated

Parameter	Limit	Unit
Supply Voltage, V _S (V _{DD} -V _{SS})	18	V
INPUT AND OUTPUT PINS		
Input Voltage (Note 2)	18	V
Input Differential Voltage, V _{ID} (Note 3)	±18	V
Input Current (through ESD protection diodes)	50	mA
Output Voltage	18	V
Output Current	20	mA
TEMPERATURE		
Storage Temperature	-65 to +150	°C
Junction Temperature	150	°C
ESD RATINGS		
Human Body Model	1500	V
Machine Model	50	V
LATCH-UP RATINGS		
Latch-up Current	100	mA

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

- 1. Stresses beyond the absolute maximum ratings can lead to reduced reliability and damage.
- 2. Excursions of input voltages may exceed the power supply level. As long as the common mode voltage [V_{CM} = (V_{IN}+ + V_{IN}-)/2] remains within the specified range, the comparator will provide a stable output state. However, the maximum current through the ESD diodes of the input stage must strictly be observed.
- 3. Input differential voltage is the non-inverting input terminal with respect to the inverting input terminal. To prevent damage to the gates, each comparator includes back-to-back zener didoes between input terminals. When differential voltage exceeds 6.2 V, the diodes turn on. Input resistors of 1 kΩ have been integrated to limit the current in this event.
- 4. This device series incorporates ESD protection and is tested by the following methods: ESD Human Body Model tested per AEC-Q100-002 (JEDEC standard: JESD22-A114) ESD Machine Model tested per AEC-Q100-003 (JEDEC standard: JESD22-A115) Latch-up Current tested per JEDEC standard: JESD78.

THERMAL INFORMATION (Note 5)

Thermal Metric	Symbol	Value	Unit
Junction-to-Ambient (Note 6)	θ_{JA}	190	°C/W
Junction-to-Case Top	Ψ_{JT}	107	°C/W

- 5. Short-circuits can cause excessive heating and destructive dissipation. Values are typical.
- 6. Multilayer board, 1 oz. copper, 400 mm² copper area, both junctions heated equally

OPERATING CONDITIONS

Parameter	Symbol	Limit	Unit
Supply Voltage (V _{DD} – V _{SS})	V _S	+2.7 to +16	V
Operating Free Air Temperature Range	T_A	-40 to +125	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

ELECTRICAL CHARACTERISTICS: $V_S = +3 V$ (**Boldface** limits apply over the specified temperature range, $T_A = -40^{\circ}C$ to +125°C.)

Parameter	Symbol	Conditions		Min	Тур	Max	Unit
INPUT CHARACTERISTICS							
Offset Voltage	Vos	V _{CM} = mid-su	pply		1.4		mV
Input Dica Current (Note 7)		\/ mid au			1		pА
Input Bias Current (Note 7)	I _{IB}	V _{CM} = mid-su	рріу			600	рA
Input Offset Current (Note 7)	los	V _{CM} = mid-supply			1		pА
input Onset Current (Note 1)	ios	v CM = 1111α−30	рріу			300	рA
Level Occurred Made Bases	.,			V _{SS}		V _{DD} – 1.5	V
Input Common Mode Range	V _{CM}			V _{SS}		V _{DD} -	V
Common Mode Rejection Ratio	CMRR	$V_{CM} = V_{SS}$ to $V_{CM} = V_{CM}$	V _{DD} – 1.5 V		70		dB
OUTPUT CHARACTERISTICS							
Output Vallage Laur	.,	V _{ID} = -1 V, I _{OL} = +6 mA			V _{SS} + 300	V _{SS} + 450	mV
Output Voltage Low	V _{OL}					V _{SS} + 700	mV
Outrot Coment High	,	V .4.V.V	.21/		2	40	nA
Output Current High	Гон	$V_{ID} = +1 V, V_{OH}$	= +3 V			1000	nA
DYNAMIC PERFORMANCE							
Propagation Delay Low to		V_{CM} = mid-supply, f = 10 kHz, R _{PU} = 5.1 kΩ,	5 mV overdrive		2.1		μS
High	t _{PLH}	$C_L = 50 \text{ pF}$	TTL input		0.6		μS
Propagation Delay High to		V _{CM} = mid-supply,	5 mV overdrive		3.9		μS
Low	t _{PHL}	$ \begin{array}{c c} f = 10 \text{ kHz}, R_{PU} = 5.1 \text{ k}\Omega, \\ C_L = 50 \text{ pF} \end{array} $ TTL input			0.2		μs
POWER SUPPLY							_
Power Supply Rejection Ratio	PSRR	V _S = +3 V to +5 V			70		dB
Quiescent Current	laa	Per channel, no load, output = LOW			6	15	μΑ
Quicocetti Cuttetti	I _{DD}					20	μΑ

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

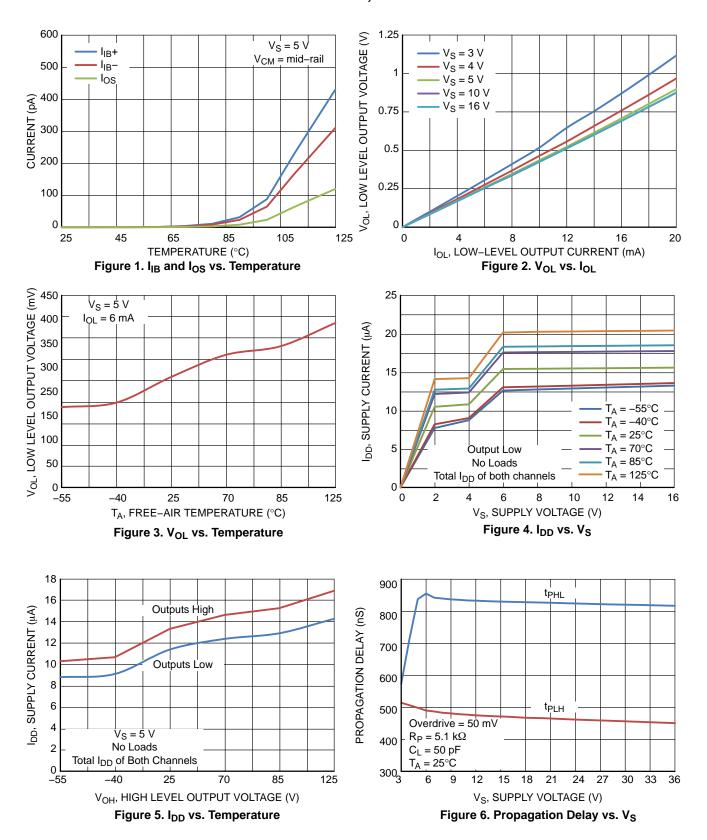
7. Guaranteed by characterization and/or design.

ELECTRICAL CHARACTERISTICS: $V_S = +5$ V, unless otherwise noted (**Boldface** limits apply over the specified temperature range, $T_A = -40^{\circ}C$ to +125°C.)

Parameter	Symbol	Conditions		Min	Тур	Max	Unit
INPUT CHARACTERISTICS	3						
Offset Voltage	Vos	$V_{CM} = mid-supply V, V_S = 5 V to 10 V$			1.4		mV
Input Bias Current		V mid a		1		рА	
(Note 8)	I _{IB}	$V_{CM} = mid-s$	supply			600	рA
Input Offset Current	l	\/ mid_6	work		1		pА
(Note 8)	los	V _{CM} = mid-s	вирріу			300	рA
Input Common Mode	V _{CM}			V _{SS}		V _{DD} – 1.5	V
Range	V CM			V _{SS}		V _{DD} – 2	v
Common Mode Rejection Ratio	CMRR	$V_{CM} = V_{SS}$ to $V_{CM} =$	= V _{DD} – 1.5 V		71		dB
OUTPUT CHARACTERISTI	cs						
Output Voltage Low	V	V 1 V I	- 16 mA		V _{SS} + 260	V _{SS} + 350	mV
Output Voltage Low	V _{OL}	$V_{ID} = -1 \text{ V, } I_{OL} = +6 \text{ mA}$				V _{SS} + 550	mV
Output Current High		V _{ID} = +1 V, V _{OH} = +5 V			2	40	nA
Output Current High	ІОН					1000	nA
DYNAMIC PERFORMANCE							
Fall Time	t _{FALL}	50 mV overdrive, f = 10 kHz, R_{PU} = 5.1 k Ω , C_L = 50 pF			25		ns
			5 mV overdrive		2.1		μS
Propagation Delay Low to		V_{CM} = mid-supply, f = 10 kHz, R_{PU} = 5.1 kΩ,	10 mV overdrive		1.2		μs
High	t _{PLH}		20 mV overdrive		0.8		μs
		$C_L = 50 \text{ pF}$	40 mV overdrive		0.5		μS
			TTL input		0.6		μS
			5 mV overdrive		5.8		μS
Propagation Delay High		V _{CM} = mid-supply,	10 mV overdrive		3.2		μS
to Low	t _{PHL}	$f = 10 \text{ kHz}, R_{PU} = 5.1 \text{ k}Ω,$	20 mV overdrive		1.7		μs
		$C_L = 50 \text{ pF}$	50 pF 40 mV overdrive		1.0		μs
		TTL input			0.3		μs
POWER SUPPLY							
Power Supply Rejection Ratio	PSRR	VS = +5 V to = +10 V			80		dB
Quiescent Current I _{DD} Per channel, no load, output = LOW				6	15	μΑ	
				20	μΑ		

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

8. Guaranteed by characterization and/or design



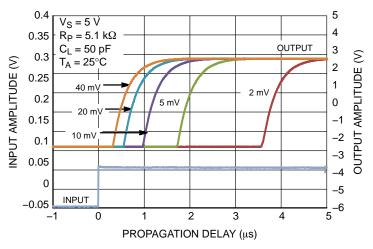
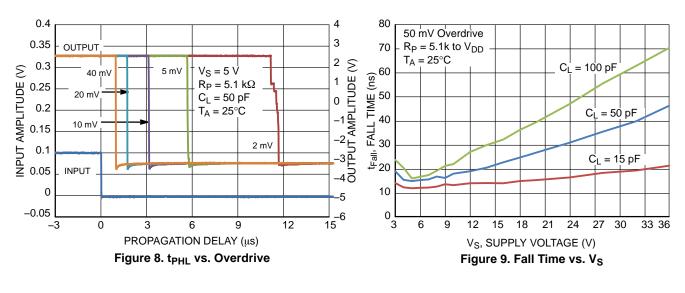
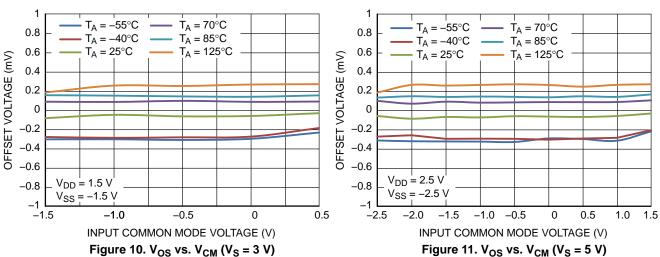


Figure 7. t_{PLH} vs. Overdrive





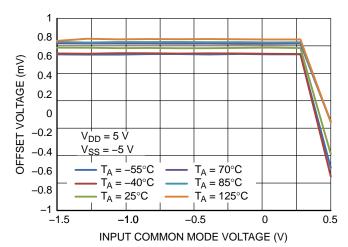
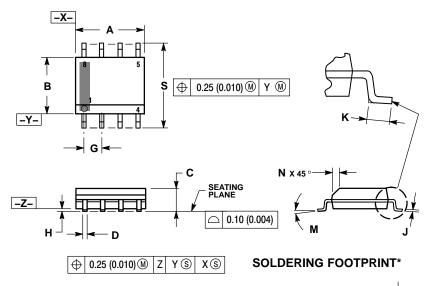


Figure 12. V_{OS} vs. V_{CM} ($V_S = 10 \text{ V}$)

PACKAGE DIMENSIONS

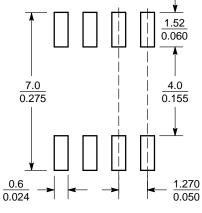
SOIC-8 NB CASE 751-07 **ISSUE AK**



NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982. CONTROLLING DIMENSION: MILLIMETER.
- DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
- MAXIMUM MOLD PROTRUSION 0.15 (0.006)
- PER SIDE.
 DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
- 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

	MILLIN	IETERS	INCHES		
DIM	MIN	MAX	MIN	MAX	
Α	4.80	5.00	0.189	0.197	
В	3.80	4.00	0.150	0.157	
С	1.35	1.75	0.053	0.069	
D	0.33	0.51	0.013	0.020	
G	1.27 BSC		0.050 BSC		
Н	0.10	0.25	0.004	0.010	
J	0.19	0.25	0.007	0.010	
K	0.40	1.27	0.016	0.050	
M	0 °	8 °	0 °	8 °	
N	0.25	0.50	0.010	0.020	
S	5.80	6.20	0.228	0.244	



*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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